(ENERGY AUDIT AND MANAGEMENT)

(INTRODUCTION TO ENERGY AUDITING&ENERGY MANAGEMENT)

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Introduction

An energy management system is a systematic process for continually improving energy performance and maximizing energy savings. The principle of an energy management is to engage and encourage staff at all levels of an organization to manage energy use on an on-going basis Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. While Energy audit is an official scientific study of energy consumption of an organization/process/plant/equipment aimed at reduction of energy consumption and energy costs without affecting productivity and comforts and suggesting the methods for energy saving and reduction in energy cost. Energy audit is carried out in planned, official manner by every energy intensive organization/plant management. This is down through the following process:

Familiarizations with the energy inlets and outlets, of energy.

Data acquisition, measurements.

Study of advanced, modern processes and plants for similar activities under audit.

Formulating energy equations and software. Economic evaluation of energy consumption in the sector/organization/plant under audit.

Analysis of energy consuming sub-processes.

Suggest energy conservation processes along with alternatives, necessary investments, payback periods, economic benefits etc.

Suggest steps to be taken for reducing energy consumption without sacrificing productivity.

The energy audit identifies the cost of energy and where and how it is used. It will identify the amount of energy expended in a process with the help of mass and energy balance for each process. Often, the energy savings is not the main driving factor when companies decide to purchase new equipment, use new processes, and use new high-tech materials. However, the combination of increased productivity, increased quality, reduced environmental emissions, and reduced energy costs provides a powerful incentive for companies and organizations to implement these new technologies.

Concept and purpose of energy audit

The main purpose of energy audit is to establish quickly and reliably, the basic relative costs of the various forms of energy purchased their main use and to identify main locations where losses, wastages or inefficiency occurs.

In simple term we can say that, energy audit helps to understand more about the ways different energy sources are used in the industry and helps to identify areas where waste can occur and where scope for improvement may be possible. Thus, energy audit is one of the concepts used in energy management and it involves methodological examination and comprehensive review of energy use in industries.

An energy audit is an inspection survey an analysis of energy flows, for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output(s). In commercial and industrial real estate, an energy audit is the first step in identifying opportunities to reduce energy expense. Energy audit is conducted by energy utilization units or its competent authorities or entrusted specialist agencies. Energy audit is a kind of scientific management method of energy. Its main content is objectively inspecting on the energy efficiency, energy consumption level and the economic benefit of the energy unit and proposing the energy-saving measures for energy-using units by means of statistical analysis, inspection testing, and diagnostic evaluation. The targets of energy audit are investigating problem and weaknesses in using energy, tapping the energy-saving potential, giving rectification measures, formulating energy saving goals and plan through the inspecting, examining, diagnosing and evaluating of the enterprise energy management level, energy consumption situation, energy consumption index, financial process, comprehensive utilization of energy. The ultimate aim of energy audit is to encourage enterprises to save energy, reduce production costs and increase economic benefit

The advantages of an energy audit

When an energy audit is conducted on your home, a professional assesses the property to determine how energy-efficient your structure is overall. This kind of audit is a good way to find out where excess energy may be creeping out of your home. It also shows you where elements of your home that are not energy-efficient may contribute to the problem. This is important because lost energy often results in higher utility bills, which can be a financial strain on you as the homeowner. Energy management is the key to saving energy in our organization. Much of the importance of energy saving stems from the global need to save energy, this global need affects energy prices, emissions targets, and legislation, all of which lead to several compelling reasons why you should save energy at your organization specifically.

Increased Comfort

Because an energy audit reveals virtual cracks in your home's ability to distribute energy - including heated and cooled air from heating, ventilation and air conditioning (HVAC) systems - you can address those issues effectively. Solutions include sealing the space around doors and windows and figuring out how to better insulate your home. The result is a cooler-feeling home during the summer months and a warmer home during the winter months.

Cost savings

Because you are no longer heating or cooling the entire outdoor area of your home, you can save money on your electric bill. When the air is contained in the space in which it was mean to distribute heated or cooled air, your system has to work less. This, in turn, means that with less electrical output from your system, you pay less each month in utilities. In many situations major cost savings can be achieved through the implementation of no cost or low-cost measures, such as:

Changing energy tariff

Rescheduling production activities to take advantage of preferential tariffs;

Adjusting existing controls so that plant operation matches the actual requirements of the building or manufacturing process;

Implementing good housekeeping policies, in which staff are encouraged to avoid energy-wasteful practices

Investing in small capital items such as thermostats and time switches.

Environmental impact

An energy audit can provide satisfaction for those people interested in conserving energy for the sake of the environment. Being more energy efficient means that your home has less of a negative environmental impact on the environment around you. An energy audit also means that you contribute less to global warming because your unit is being more efficient and releasing fewer carcinogens and other harmful emissions into the air.

Improved resale value

Your home resale value is greatly improved with a professional energy audit. The renovations that you make to improve energy efficiency will increase the value of your home. In fact, home improvements for the sake of energy efficiency are the only home improvements that actually pay for themselves in the long run.

The global need to save energy

If it wasn't for the global need to save energy, the term "energy management" might never have even been coined. Globally we need to save energy in order to:

Reduce the damage that we're doing to our planet, Earth. As a human race we would probably find things rather difficult without the Earth, so it makes good sense to try to make it last.

Reduce our dependence on the fossil fuels that are becoming increasingly limited in supply.

Controlling and reducing energy consumption at your organization
Energy management is the means to controlling and reducing your organization's energy consumption. Controlling and reducing your organization's energy consumption is important because it enables you to:

Reduce costs

This is becoming increasingly important as energy costs rise.

Reduce carbon emissions and the environmental damage that they cause as well as the cost-related implications of carbon taxes and the like, your organization may be keen to reduce its carbon footprint to promote a green, sustainable image. Not least because promoting such an image is often good for the bottom line.

Reduce risk –

the more energy you consume, the greater the risk that energy price increases or supply shortages could seriously affect your profitability, or even make it impossible for your business/organization to continue. With energy management you can reduce this risk by reducing your demand for energy and by controlling it so as to make it more predictable.

How best to manage your energy consumption?

Four steps to the energy-management process are identified. Each of them in turn will be covered:

Metering your energy consumption and collecting the data:

As a rule of thumb, the more data you can get, and the more detailed it is, the better.

The old approach to energy-data collection is to manually read meters once a week or once a month. This is quite a chore, and weekly or monthly data is not nearly as good the data that comes easily and automatically from the modern approach...

The modern approach to energy-data collection is to fit interval-metering systems that automatically measure and record energy consumption at short, regular intervals such as every half hour. There is more about this on our page about interval data.

Detailed interval energy consumption data makes it possible to see patterns of energy waste that it would be impossible to see otherwise. For example, there is simply no way that weekly or monthly meter readings can show you how much energy you are using at different times of the day, or on different days of the week. And seeing these patterns makes it much easier to find the routine waste in your building.

Finding and quantifying opportunities to save energy:
The detailed meter data that you are collecting will be invaluable for helping you to find and quantify energy-saving opportunities. The easiest and most cost-effective energy-saving opportunities typically require little or no capital investment.

For example, an unbelievable number of buildings have advanced control systems that could be controlling HVAC, but, unknown to the facilities-management staff, are faulty or misconfigured of heating or cooling an empty building every time.

(NB "HVAC" is just an industry acronym for Heating, Ventilation and Air Conditioning. It is a term that is more widely used in some countries than others.)

And one of the simplest ways to save a significant amount of energy is to encourage staff to switch equipment off at the end of each working day.

Looking at detailed interval energy data is the ideal way to find routine energy waste. You can check whether staff and timers are switching things off without having to patrol the building day and night, and, with a little detective work, you can usually figure out who or what is causing the energy wastage that you will inevitably find. And, using your detailed interval data, it is usually pretty easy to make reasonable estimates of how much energy is being wasted at different times. For example, if you have identified that a lot of energy is being wasted by equipment left on over the weekends, you can:

(a)Use your interval data to calculate how much energy (in kWh) is being used each weekend.

(b)Estimate the proportion of that energy that is being wasted (by equipment that should be switched off).

Using the figures from a&b, calculate an estimate of the total kWh that are wasted each weekend.

It will be useful for helping you to quantify the potential savings that each opportunity could bring. It is much more reliable to base your savings estimates on real metered data than on rules of thumb alone. And it is critically important to quantify the expected savings for any opportunity that you are considering investing a lot of time or money into - it is the only way you can figure out how to hone in on the biggest, easiest energy savings first.

Targeting the opportunities to save energy

Just finding the opportunities to save energy will not help you to save energy, you have to take action to target them.

For those energy-saving opportunities that require you to motivate the people in your building, article on energy awareness should be used. It can be hard work, but, if you can get the people on your side, you can make some seriously big energy savings without investing anything other than time.

As for those energy-saving opportunities that require you to upgrade equipment or insulation assuming you have identified them, there I s little more to be said. Just keep your fingers crossed that you make your anticipated savings and be thankful that you don't work for the sort of organization that won't invest in anything with a payback period over 6 months.

Tracking your progress at saving energy

Once you have taken action to save energy, it is important that you find out how effective your actions have been:

Energy savings that come from behavioral changes (e.g. getting people to switch off their computers before going home) need ongoing attention to ensure that they remain effective and achieve their maximum potential.

If you have invested money into new equipment, you will probably want to prove that you have achieved the energy savings you predicted.

If you have corrected faulty timers or control-equipment settings, you will need to keep checking back to ensure that everything is still working as it should be. Simple things like a power cut can easily cause timers to revert back to factory settings if you are not keeping an eye on your energy-consumption patterns you can easily miss such problems.

If you have been given energy-saving targets from above, you will need to provide evidence that you are meeting them, or at least making progress towards that goal.

And occasionally you might need to prove that progress is not being made (e.g. if you are at your wits' end trying to convince the decision makers to invest some money into your energy-management drive).

Areas of application of energy management system

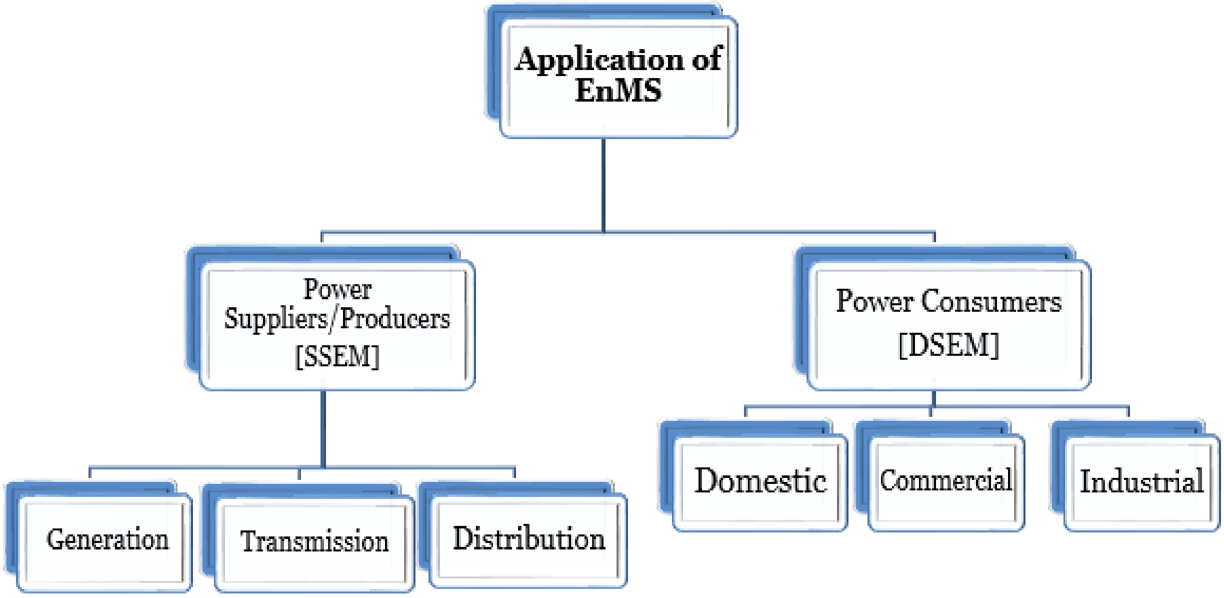


Figure 1: Areas of application of EnMS

Abbreviations: DSEM: Demand Side Energy Management

GSEM: Supply Side Energy Management

General procedure for a detailed energy audit

To perform an energy audit, several tasks are typically carried out depending on the type of the audit and the size and function of the building. Some of the tasks may have to be repeated, reduced in scope, or even eliminated based on the findings of other tasks. Therefore, the execution of an energy audit is often not a linear process and is rather iterative. However, a general procedure can be outlined for most buildings

Step 1: Building and Utility Data Analysis

The main purpose of this step is to evaluate the characteristics of the energy systems and the patterns of energy use for the building. The building characteristics can be collected from the architectural/ mechanical/electrical drawings and/or from discussions with building operators. The energy use patterns can be obtained from a compilation of utility bills over several years. Analysis of the historical variation of the utility bills allows the energy auditor to determine any seasonal and weather effects on the building energy usage. Some of the tasks that can be performed in this step are presented below, with the key goals expected from each task noted in bullets:

Collect at least 3 years of records of utility data [to identify a historical energy use pattern]

Identify the fuel types used (electricity, natural gas, oil, etc.) [to determine the fuel type that accounts for the largest energy use]

Determine the patterns of fuel use by fuel type [to identify the peak demand for energy use by fuel type]

Understand utility rate structure (energy and demand rates) [to evaluate if the building is penalized for peak demand and if cheaper fuel can be purchased]

Analyze the effect of weather on fuel consumption.

Perform utility energy use analysis by building type and size (building signature can be determined including energy use per unit area [to compare against typical indices]

Step 2: Walk-Through Survey

This step should identify potential energy savings measures. The results of this step are important since they determine if the building warrants any further energy auditing work. Some of the tasks involved in this step are

Identify the customer’s concerns and needs

Check the current operating and maintenance procedures

Determine the existing operating conditions of major energy use equipment (lighting, HVAC systems, motors, etc.)

Estimate the occupancy, equipment, and lighting (energy use density and hours of operation)

Step 3: Baseline for Building Energy Use

The main purpose of this step is to develop a base-case model that represents the existing energy use and operating conditions for the building. This model will be used as a reference to estimate the energy savings due to appropriately selected energy conservation measures. The major tasks to be performed during this step are:

Obtain and review architectural, mechanical, electrical, and control drawings

Inspect, test, and evaluate building equipment for efficiency, performance, and reliability

Obtain all occupancy and operating schedules for equipment (including lighting and HVAC systems)

Develop a baseline model for building energy use

Calibrate the baseline model using the utility data and/or metered data

Step 4: Evaluation of Energy-Saving Measures

In this step, a list of cost-effective energy conservation measures is determined using both energy savings and economic analysis. To achieve this goal, the following tasks are recommended:

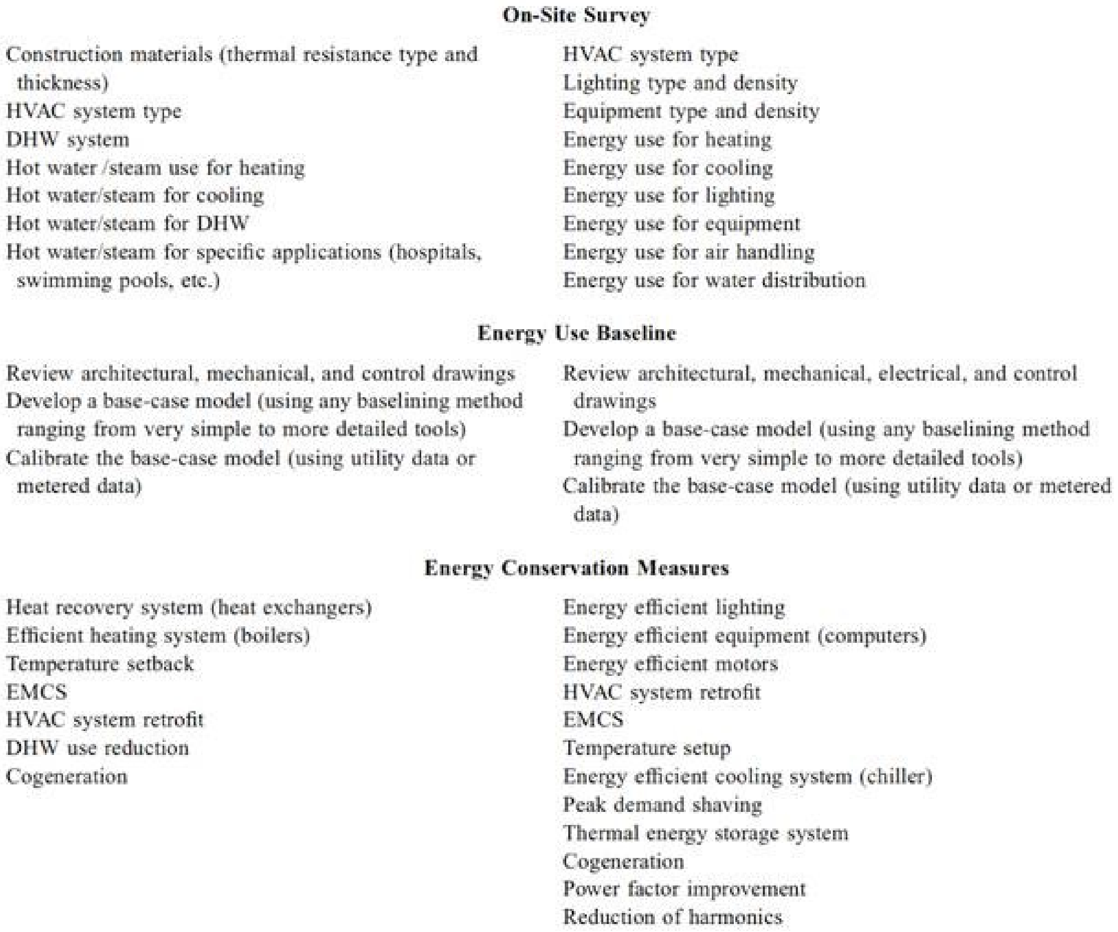
Prepare a comprehensive list of energy conservation measures (using the information collected in the walk-through survey)

Determine the energy savings due to the various energy conservation measures pertinent to the building by using the baseline energy use simulation model developed in Step 3

Estimate the initial costs required to implement the energy conservation measures

Evaluate the cost-effectiveness of each energy conservation measure using an economic analysis method (simple payback or life-cycle cost analysis

Tables 1.0 and 1.1 provide summaries of the energy audit procedure recommended, respectively, for commercial buildings and for industrial facilities.



On-Site Survey	
Construction materials (thermal resistance type and thickness)	HVAC system type
HVAC system type	Lighting type and density
DHW system	Equipment type and density
Hot water /steam use for heating	Energy use for heating
Hot water/steam for cooling	Energy use for cooling
Hot water/steam for DHW	Energy use for lighting
Hot water/steam for specific applications (hospitals, swimming pools, etc.)	Energy use for equipment
	Energy use for air handling
	Energy use for water distribution
Energy Use Baseline	
Review architectural, mechanical, and control drawings	Review architectural, mechanical, electrical, and control drawings
Develop a base-case model (using any baselining method ranging from very simple to more detailed tools)	Develop a base-case model (using any baselining method ranging from very simple to more detailed tools)
Calibrate the base-case model (using utility data or metered data)	Calibrate the base-case model (using utility data or metered data)
Energy Conservation Measures	
Heat recovery system (heat exchangers)	Energy efficient lighting
Efficient heating system (boilers)	Energy efficient equipment (computers)
Temperature setback	Energy efficient motors
EMCS	HVAC system retrofit
HVAC system retrofit	EMCS
DHW use reduction	Temperature setup
Cogeneration	Energy efficient cooling system (chiller)
	Peak demand shaving
	Thermal energy storage system
	Cogeneration
	Power factor improvement
	Reduction of harmonics

Table 1.0: Energy Audit summary for Residential and commercial Buildings

ARE YOU TIRED OF PAYING HEFTY ELECTRICITY BILLS YOU CHECK HERE TO LEARN HOW TO BUILD A GENERATOR THAT GENERATES ELECTRICITY FOR FREE 24-7?

On-Site Survey

List of equipment that use thermal energy	List of equipment that use electrical energy
Perform heat balance of the thermal energy	Perform heat balance of the electrical energy
Monitor thermal energy use of all or part of the equipment	Monitor electrical energy use of all or part of the equipment
Determine the by-products of thermal energy use (such as emissions and solid waste)	Determine the by-products of electrical energy use (such pollutants)

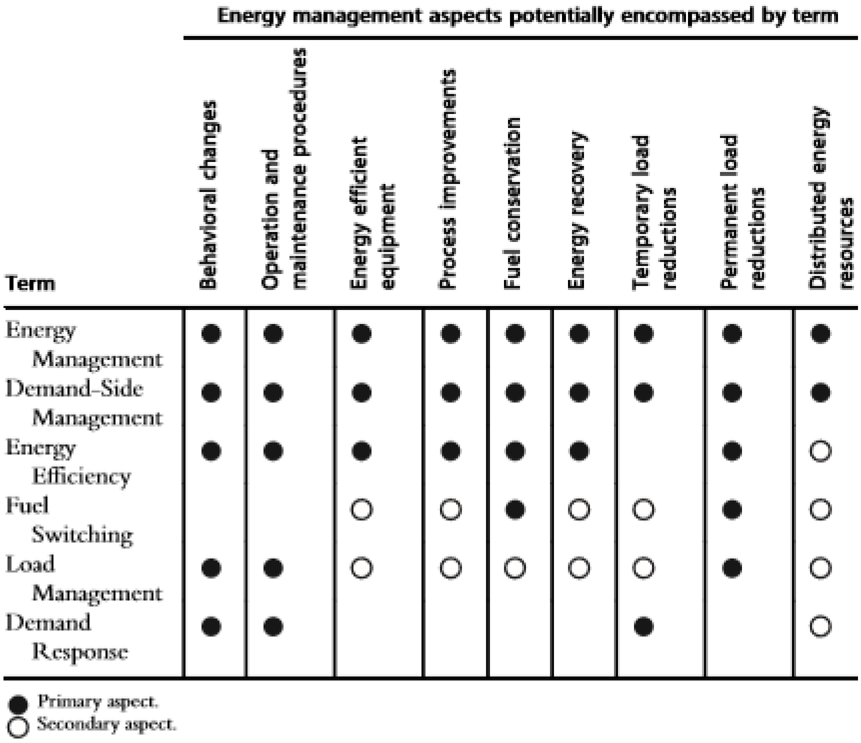
Energy Use Baseline

Review mechanical drawings and production flow charts	Review electrical drawings and production flow charts
Develop a base-case model using (any baselining method)	Develop a base-case model (using any baselining method)
Calibrate the base-case model (using utility data or metered data)	Calibrate the base-case model (using utility data or metered data)

Energy Conservation Measures

Heat recovery system	Energy efficient motors
Efficient heating and drying system	Variable speed drives
EMCS	Air compressors
HVAC system retrofit	Energy efficient lighting
Hot water and steam use reduction	HVAC system retrofit
Cogeneration (possibly with solid waste from the production line)	EMCS
	Cogeneration (possibly with solid waste from the production line)
	Peak demand shaving
	Power factor improvement
	Reduction of harmonics

Table 1.1: Energy Audit summary for Industrial facilities



	Energy management aspects potentially encompassed by term								
Term	Behavioral changes	Operation and maintenance procedures	Energy efficient equipment	Process improvements	Fuel conservation	Energy recovery	Temporary load reductions	Permanent load reductions	Distributed energy resources
Energy Management	●	●	●	●	●	●	●	●	●
Demand-Side Management	●	●	●	●	●	●	●	●	●
Energy Efficiency	●	●	●	●	●	●		●	○
Fuel Switching			○	○	●	○	○	●	○
Load Management	●	●	○	○	○	○	○	●	○
Demand Response	●	●					●		○

● Primary aspect.
○ Secondary aspect.

Table 2.0: Energy management terminology

Energy Management and Demand-Side Management

Energy management: is used because it encompasses all aspects of managing energy, ranging from behavioral changes and better operation and maintenance practices to energy efficient equipment retrofits and process improvements to fuel conservation and energy recovery to temporary and permanent peak demand reductions and even to distributed energy resources.

Demand-side management: is another term that encompasses all aspects of managing energy, but it is generally associated specifically with utility programs aimed at improving energy use at customer sites, the “demand” side of the meter. Perhaps the most widely accepted definition of demand-side management is the following: “Demand-side management is the planning, implementation, and monitoring of those utility activities designed to influence customer use of electricity in ways that will produce desired changes in the utility’s load shape, that is, changes in the time pattern and magnitude of a utility’s load. Utility programs falling under the umbrella of demand-side management include: load management, new uses, strategic conservation, electrification, customer generation, and adjustments in market share. This definition can extend to suppliers of all forms of energy, not just electric utilities. Energy management practices by the user can relate to reduction in and better control of energy use (kilowatt hours of electricity or joules, through more efficient systems and automated controls. Or the user can take measures to reduce needed capacity to obtain more favorable energy pricing. For the second point, it is conceivable for a homeowner to switch off the electric water heater or increase thermostat set-points for the air conditioning system simply to save money on kilowatt hour or demand charges. These actions might be done at the homeowner’s convenience for example during the evening hours when demand for hot water is low or during the weekday when family members are at work or school. Or the utility might provide encouragement by giving a favorable electricity rate during the evening. Thus, by providing appropriate storage capacity controls, the user could meet hot water requirements by off-peak electricity use or the air conditioning controls could automatically decrease the temperature set-points to begin cooling the house with off-peak electricity shortly before occupants return home. It is possible to have a situation where the strategy would be the same regardless of who implemented it, but the ends might be quite different depending on whether the action was taken by the utility or by the customer.

Energy Efficiency

The term energy efficiency refers to using an alternative method, process, or piece of equipment to produce a given outcome (a product or service, for example) with less energy. Implementation of these types of change hinges largely on the availability of technology and economic justification.

Load Management and Demand Response

Load management refers to the supply end of the system and encompasses those activities taken by utilities to manipulate the load seen by their generating systems to achieve the most favorable and economic operating condition. Generally, the utilities’ major concerns will be to improve their load factor and reduce peak demand wherever possible since a high peak demand requires maintaining generating capacity that is infrequently used and is expensive both in terms of initial capital cost and operation. Demand response is a subset of load management that refers to actions that temporarily reduce load in response to price or other signals from the utility. It is often differentiated from other load management strategies, like thermal energy storage or energy efficiency improvements that yield permanent load reductions. An example would be to have electricity customers reduce their consumption at critical times or in response to market prices. Demand response can be driven by one of two methods: incentive-based (direct load control, interruptible/curtail able rates, demand bidding/buyback programs, etc.), or time-based rates (time-of-use rates, critical-peak pricing, and real-time pricing).

Energy Management Units

Most nations of the world have approved the International System of Units (SI), although complete adoption has not occurred in certain countries (most of them English-speaking). SI units are used throughout this report, with non-SI units in common use sometimes shown in parentheses for clarity. The units for energy and power are the joule and the watt:

Energy; heat; work: Joule (J) = newton.meter = watt.second

Power: Watt (W) = 1 joule/second

These units are small for practical purposes so we use Gigajoules (10^9J) or Megawatts (10^6W) for large quantities and Megajoules (MJ) or kilowatts (kW) for most energy management applications. For convenience, we often use kilowatt-hours (equal to 3.6 MJ) when referring specifically to electrical energy.

Methodology for calculating the energy performance of buildings

This regulation establishes the methods for calculating the energy performance of buildings to prove their compliance with the minimum requirements for energy performance.

Definitions

Technical systems

The heating system and the system of hot household water including the corresponding heat sources, the ventilation system, the cooling system, lighting and the systems which generate heat or electricity locally and are included in the energy calculation in accordance with this regulation.

Indoor Climate Control

The use of energy for the purpose of ensuring the quality of indoor air, including maintaining, increasing or reducing indoor temperature, in compliance with the ventilation and room temperature requirements established in this regulation, and for the purpose of lighting under the building’s standard use.

Energy Network

A system for the transmission of energy and for the distribution of energy to consumers (such as the power network, district heating and district cooling network, natural gas network).

Building Leakage Rate

The parameter which characterizes the airtightness of the building envelope and which is determined by means of an air leakage test at a pressure difference of 50 Pa. The building's average leakage rate [m3/(h m2)] is expressed per square meter of the building envelope. The area of the envelope is calculated on the basis of the internal dimensions of the building.

Delivered Energy

The electricity obtained from power networks or the heat obtained from district heating networks in kilowatt-hours per annum (kWh/y) or the energy content (in kilowatt-hours) of fuel which is obtained from fuel suppliers and which is used to cover the building's annual aggregate energy use in so far as this is not covered by local renewable energy. Any fuel obtained from the building site is deemed to constitute delivered energy;

Total Energy Use (kWh/y) Of the Building

Use of heat and electricity by the building's technical systems required for indoor climate control, the heating of household water and the operation of electrical equipment, excluding local renewable energy (excepting heat pumps). The building's total energy use includes all energy losses of the technical systems, including heat sources and the distribution systems of local energy generation, and the conversion of energy (e.g., coefficient of performance of a heat pump, energy efficiency ratio of a cooling plant, cogeneration, and fuel cell).

Energy Performance Indicator[kWh/(m2y)]

Calculated total weighted specific use of delivered energy consumed in the course of standard use of the building, from which the weighted specific use of exported energy is subtracted.

Specific heat loss of the building envelope [W/K]

specific heat loss via the building envelope in watts when the difference between outdoor and indoor temperature is one degree Celsius;

Total Specific Heat Loss of The Building Envelope per Square Metre of Heated Area [W/(m2K)]

total specific heat loss via the building envelope per square metre of heated area of the building at difference of one degree Celsius between indoor and outdoor temperature. The specific heat loss is the sum of the heat losses that result from conduction and infiltration through the building envelope.

Energy Need

the electrical and thermal energy (without taking into account system losses and conversions from one energy type to another) required for indoor climate control, the heating of household water, lighting, and the operation of equipment. The energy need comprises: energy need for space heating, space cooling, the heating of ventilation air, the cooling of ventilation air, ventilation, the heating of household water, lighting and the operation of equipment;

Energy Need for Space Heating

the amount of thermal energy required for the heating of rooms to indoor temperature, taking into account heat gains, heat losses that result from conduction and infiltration through the building envelope and the heating of ventilation supply air to indoor temperature;

Energy Need for Space Cooling

the amount of thermal energy required for the cooling of rooms to indoor temperature, including both latent and sensible heat, taking into account heat gain, conduction and infiltration through the building envelope and the temperature of ventilation supply air;

Energy Need for The Heating of Household Water

the amount of thermal energy required for the heating of household water;

Energy Need for The Heating of Ventilation Air

the amount of thermal energy required for the heating of ventilation air to supply temperature, from which recovered heat is deducted; in the case of a ventilation system without heat recovery, the amount of thermal energy required for the heating of ventilation air from the outdoor temperature to indoor temperature.

Energy Need for The Cooling of Ventilation Air

the amount of thermal energy required for the cooling of air, including both latent and sensible heat;

Energy Use

use of electrical or thermal energy at a given point in the system. Energy use is calculated on the basis of energy need, taking into account system losses and energy conversion losses. At the end-point of a technical system of the building (usually the connection point to the corresponding energy network), the energy use of the utility system equals the sum of delivered energy and local renewable energy.

Usage rate means the average use intensity of lighting and appliances and the average presence of occupants during the building’s occupied hours. The maximum heat release value (usage rate = 1) is used in the calculations of summertime indoor temperatures and cooling loads. For the purposes of the energy calculation, the maximum heat release value is multiplied by the usage rate value. The annual heat release Q $[kWh/(m^2y)]$ of lighting and appliances and the internal heat gain from occupants is calculated using the following formula:

$$Q = kP\frac{\tau_d}{24}\frac{\tau_w}{7}\frac{8760}{1000}$$

where k is the rate of usage;
P is heat release W/m^2;
τ_d is the building's number of occupied hours per 24-hour day;
τ_w is the building's number of days of occupancy per week.

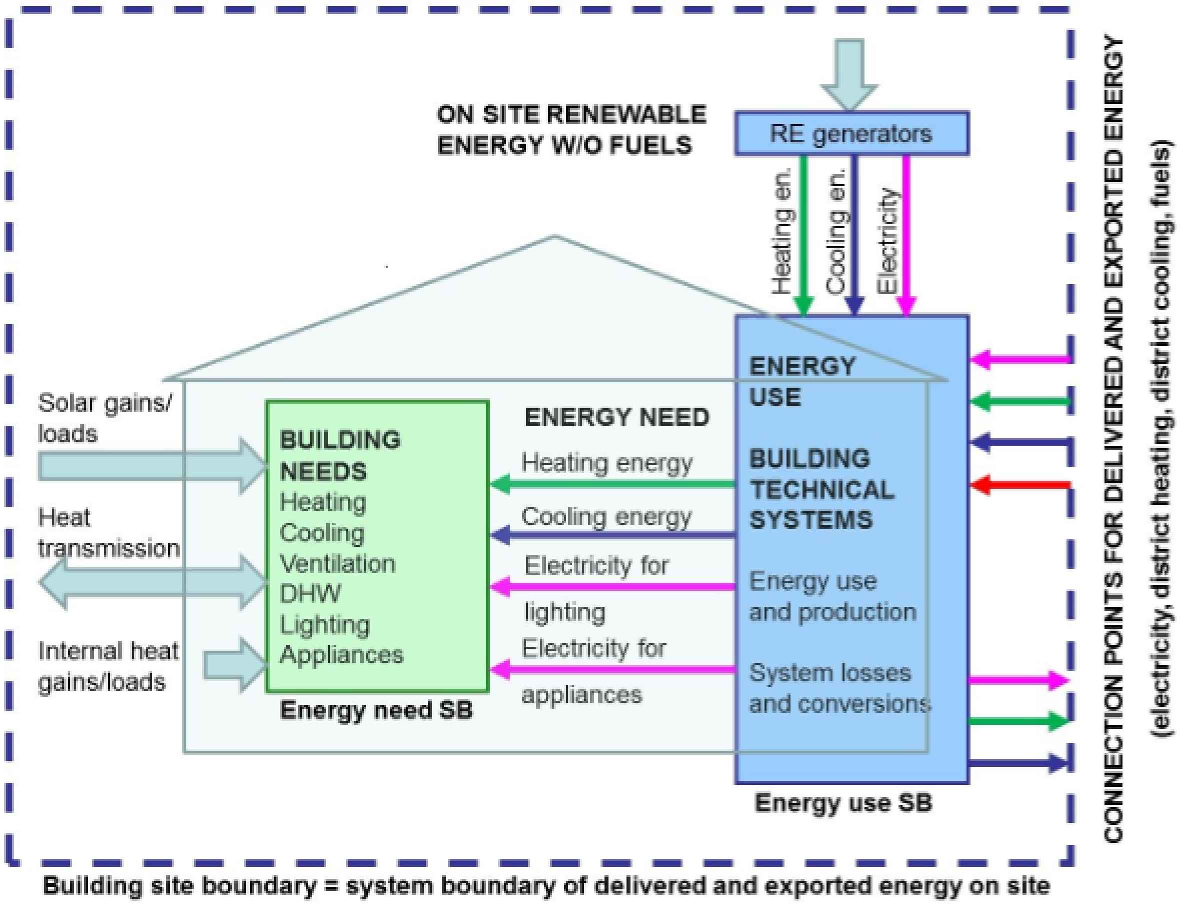

ON SITE RENEWABLE ENERGY W/O FUELS
RE generators
Heating en.
Cooling en.
Electricity
Solar gains/ loads
Heat transmission
Internal heat gains/loads
BUILDING NEEDS
Heating
Cooling
Ventilation
DHW
Lighting
Appliances
Energy need SB
ENERGY NEED
Heating energy
Cooling energy
Electricity for lighting
Electricity for appliances
ENERGY USE
BUILDING TECHNICAL SYSTEMS
Energy use and production
System losses and conversions
Energy use SB
CONNECTION POINTS FOR DELIVERED AND EXPORTED ENERGY
(electricity, district heating, district cooling, fuels)
Building site boundary = system boundary of delivered and exported energy on site

Figure 2.0: System boundary of delivered and exported energy.

Basic components of an energy audit (instrumentation for auditing)

A hefty utility bill can take a chunk out of the family budget every month, particularly if the weather is very cold or exceedingly hot. An energy audit can assist a homeowner in identifying places in a home where money is being wasted due to energy loss. Understanding what is entailed in an energy audit can help you better assess the results, so changes leading to reduced energy consumption can be implemented.

The auditor must make some measurements during the audit visit. The amount of equipment needed depends on the type of energy-consuming equipment used at the facility.

Tape Measures:

The most basic measuring device needed is the tape measure. A 25-foot tape measure l" wide and a 100- foot tape measure are used to check the dimensions of walls, ceilings, windows, etc.

Thermometers:

Several thermometers are generally needed to measure temperatures in offices and other worker areas, and to measure the temperature of operating equipment. Knowing process temperatures allows the auditor to determine process equipment efficiencies, and also to identify waste heat sources for potential heat recovery programs.

Electric Power Meters:

An inexpensive Electric Power Meters are useful for determining operating voltages, power factor is very handy for determining the power consumption and power factor of individual motors and other inductive devices. On electrical equipment and especially useful when the nameplate has worn off of a piece of equipment or is otherwise unreadable or missing.

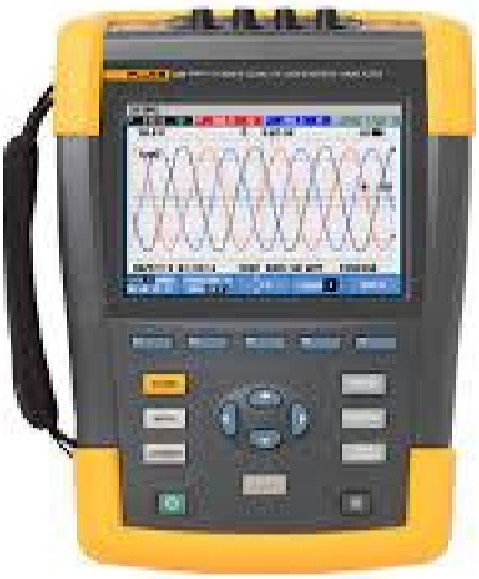


Figure 3.0: power-quality-analyzers

Combustion Analyzer:

Combustion analyzers are portable devices capable of estimating the combustion efficiency of furnaces, boilers, or other fossil fuel burning machines.

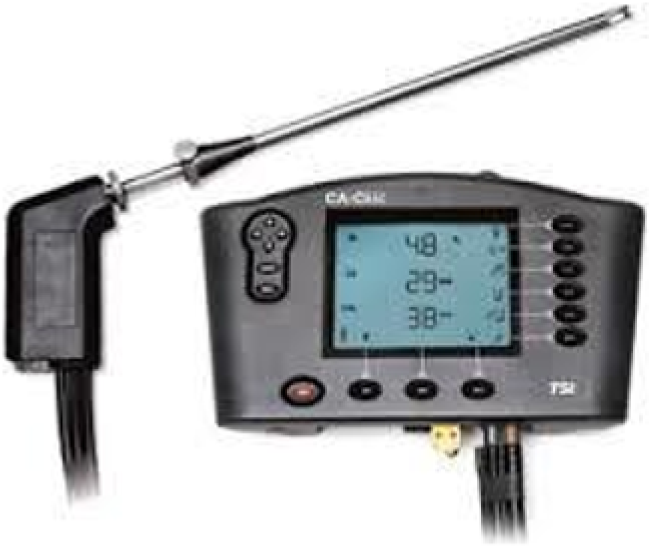


Figure 4.0: Combustion Analyzer Kit,

Digital Thermometer:

Several thermometers are generally needed to measure temperatures in offices and other worker areas, and to measure the temperature of operating equipment. Knowing process temperatures allows the auditor to determine process equipment efficiencies, and also to identify waste heat sources for potential heat recovery programs.

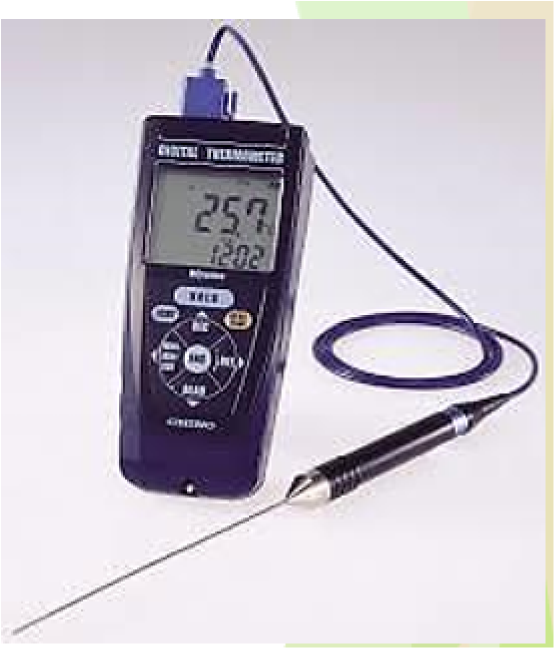


Figure 5.0: Digital Thermometer

Psychrometer (Humidity Measurement):

A psychrometer measures the relative humidity in the atmosphere through the use of two thermometers. A dry bulb thermometer, is used to measure the temperature by being exposed to the air. A wet bulb thermometer, measures temperature by having the bulb dipped in a liquid.

Through the comparison of both temperatures, individuals determine the relative humidity of the surrounding area by calculating the difference between the temperatures.

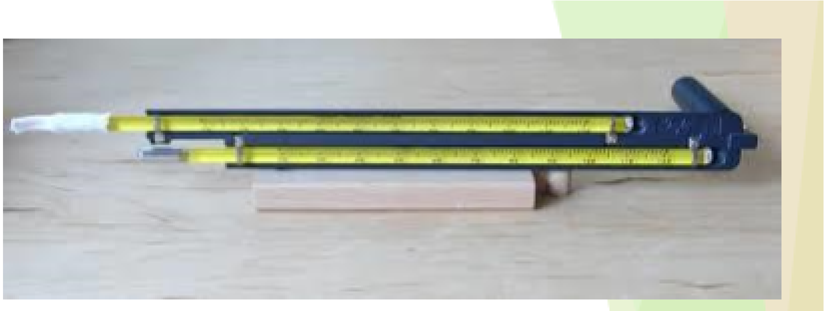


Figure 6.0: **Psychrometer (Humidity Measurement)**

Air Flow Measurement Devices:

Airflow meters are basically mass flow meters, as they determine the air velocity and air pressure by measuring the mass flow of a medium, which is air in this case. The air flow meter is ideal for taking quick or constant measurements including monitoring of ventilation installations, process checking, industrial applications, use in private workshops or by nautical enthusiasts or for other hobbies.

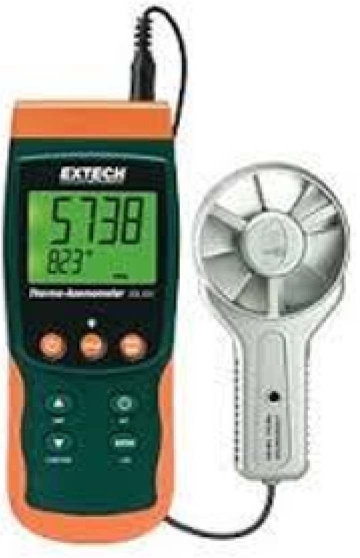


Figure 7.0: **Air Flow Measurement Devices**

Safety Considerations

The auditor should be careful when examining any operating piece of equipment, especially those with open drive shafts, belts or gears, or any form of rotating machinery. The equipment operator or supervisor should be notified that the auditor is going to look at the piece of equipment and might need to get information from some part of the device. If necessary, the auditor may need to come back when the machine or device is idle in order to safely get the data. The auditor should never approach a piece of equipment and inspect it without the operator or supervisor being notified first.

Safety Equipment:

The use of safety equipment is a vital precaution for any energy auditor. A good pair of safety glasses is an absolute necessity for almost any audit visit. Hearing protectors may also be required on audit visits to noisy plants or areas with high horsepower motors driving fans and pumps. Electrical insulated gloves should be used if electrical measurements will be taken, and asbestos gloves should be used for working around boilers and heaters. Breathing masks may also be needed when hazardous fumes are present from processes or materials used.

Evaluation or Air Leakage

One of the most important parts of an energy audit is checking for trouble spots where air is leaking out of a home. Even small leaks can result in a significant amount of energy loss over time. An HVAC unit will have to work harder to offset the loss of warm or cool air, resulting in a higher utility bill.

A device called a blower door is used to measure air leakage. It is positioned in the frame of an external door. Air gets sucked out of the home when the blower door fan is turned on, resulting in lower indoor air pressure. Exterior air will be drawn back inside through any gaps or holes in the house due to its elevated air pressure. An airflow manometer and hoses can help to gauge airflow, and the information collected from the door of a calibrated blower assists in the computation of total air leakage. If a home is under construction, the optimal time to do a blower test is following the insulation of the home, but prior to the installation of drywall. Adhering to that order will make it easier to fix any issues that are identified by the test. A blower door test typically takes at least an hour. Test time will vary based on the size and layout of a home.

In order to get the most accurate results, some home preparation is needed for a blower door test. An energy auditor can help you prepare for the test. All windows and exterior doors must be shut, with the exception of the blower door. Doors inside the home should be left open. Heating systems and non-electric water heaters should be disabled so they do not turn on during the test. All fires should be extinguished in fire places and wood stoves, and dampers need to be closed. The clothes dryer and any bathroom or kitchen exhaust fans should be off.

An energy auditor can use an infrared camera, also called a thermal imaging camera, in conjunction with a blower door to further investigate potential air leaks. It is much easier to detect the source of leaks with thermal imaging as many leaks are

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not visible to the naked eye. An infrared camera can provide more detailed information on the root causes of identified air leaks.

Assessment of Insulation

If a home has inadequate insulation, it makes it much easier for heat to escape in the winter, and cool air-conditioned air to leave in the summer. By measuring the thickness of insulation, an energy auditor can help determine if there is a sufficient amount, and make recommendation if needed. Newer homes are more likely to be properly insulated, but standards can change over time so it is important to periodically re-asses' insulation levels. Older homes are at greater risk for not having enough, since there may not have been any insulation requirements when they were built. An energy audit can help homeowners determine if they have adequate insulation.

Examination of Water Usage

Water consumption is another thing an energy auditor can measure. Using excessive amounts of water can also contribute to an increased utility bill. High-efficiency shower heads, toilets and washing machines are all innovations that can assist in water conservation. An energy audit can identify shower heads, toilets and washing machines that are wasting water. An old water heater may also contribute to a higher energy bill. Newer tank-less water heaters tend to use less energy because they are only on when you need hot water. Older models need to always be in use so there is hot water available. An energy auditor may suggest replacing an old water heater. There may be rebates available for installing devices that lower water consumption.

Benefits of Energy Audits

In any process plant, energy in form of heat is required to carry out multiple processes. This heat is supplied using a heating medium like steam, hot water or thermic fluids. Energy audit or thermal audit helps to measure, analyze and improve the performance of utility system.

It is a common myth that energy audit or thermal audit is only about energy conservation. In reality, an energy audit helps improve the plant on various fronts like energy efficiency, reliability, productivity, product quality and safety.
Some of the important benefits of energy/thermal audits are as follows-

Benchmarking and evaluating potential for improvement

Analyzing audit data of hundreds of plants across each industry reveals that there exists a huge difference between the fuel costs of different plants manufacturing the

same product. Even the best managed plants have a further potential of saving 20%. Energy audits let the plant personnel know how efficiently their plants operate when compared with industry best plants.
Energy audits also help to understand the practically attainable savings, expenditure to attain them and the payback period.

Evaluation of actual performance of the utility system.

Energy audits help to evaluate the actual performance of the utility system. During the course of operation, the system performance deviates from the ideal performance. A steam audit actually finds out the energy and mass balance of the system and gives actual numbers.

Identification of specific issues relating to process control

Each process has its own requirement in terms of heat transfer rate, temperature etc. Energy audit helps to find out if these requirements are being met or not. For instance, supplying steam at a pressure higher than required brings down the overall operational efficiency as high pressure steam has lower latent heat and forms more flash steam.

Carrying out an energy audit will help to locate and address many such process control related issues. Addressing such issues will not only bring down the fuel consumption, but will also improve the product quality and eliminate elongated batch timings.

Debottlenecking/ troubleshooting of recurring problems

Energy audits involve analyzing recurring problems and coming up with solutions for them without compromising on other parameters.

Spare capacity

Carrying out an energy audit and implementing the suggested solutions can release some spare capacity which can be used to increase the production. This gives the unique benefit of increasing production without any capital investment.

Meeting environmental compliances and norms

In the process of energy audit, any unmet environmental compliances are brought to the notice of the plant personnel and suitable actions are suggested. This also brings down the carbon footprint.

Improved product quality

Issues like steam starvation, improper pressure/temperature within the process, poor condensate evacuation negatively affect the product quality. Energy audit suggestions help to resolve these issues. This improves the product quality and minimizes the rejections.

Social:

A wide adoption of EnMS in a country/region will see to the creation of jobs owing to the demand for more Energy Managers and production of more efficient energy conversion machines & components

Economic

Reduction in operational cost owing to reduction in energy consumed & improved efficiency

Increase in efficiency of machines, leading to increase in productivity

Increase in Reliability/Energy Security:

Interruption of productive activity or services owing to unforeseen fluctuation of the cost of energy or interruption in supply, can be ameliorated via contingency plans that is conceived in the implementation of EnMS.

Types of Energy Audit:

The energy audit can be of following two types:

- Preliminary Energy audit.
- Detailed Energy audit.

Preliminary Energy audit:

Preliminary audit is carried out in the limited time say within 10 days and it highlights the energy cost and wastages in the major equipment's and processes. It also gives the major energy supplies and demanding accounting. The questionnaire containing the industrial details of energy consumption process carried out, energy need to unit product; load data etc. must be completed before the pre-audit visit.

The pre-audit visit is done, by the audit team/audit consultant, in the plant area with the attention focused on the energy inputs, spots of wastage and available energy conservation opportunities. The items for waste recycling opportunities are identified. The data regarding energy inputs and outputs are collected for use during preliminary audit.

During the visit, discussions with line supervisors and line technicians and joint brainstorming may be necessary to acquire creative ideas and to know the practical difficulties in carrying out the proposed energy conservation measures (ECMs).

After the pre-audit visit, the work of energy audit is undertaken. In the preliminary audit, low tech recommendations are preferred. High tech solutions are given under detailed energy audit. Some of the low cost recommendations may be: Switching off lights when not required, replace incandescent lamps by the fluorescent lamps, automatic thermostat control, use of solar water heating panels etc.

The preliminary audit spots energy waste spots and recommend short, intermediate and long term solutions. It should adopt step by step and cautious approach for improvements and new techniques of energy management and control system.

Detailed (Comprehensive) Energy Audit:

Detailed energy audit, also known as comprehensive energy audit includes engineering recommendations and well-defined projects with priorities. It accounts for the total energy utilized in plants. It involves detailed engineering for options to reduce energy consumption and also reduce cost. The duration of such studies is generally from 1 to 10 weeks. The action plan in divided into short term, medium term and long-term actions.

The short-term action plan requires no capital investment or least investment to avoid energy wastages and minimizing non-essential energy uses and improving the system efficiency through improved maintenance programmed.

The medium-term action plan requires a little investment to achieve efficiency improvement through modifications of existing equipment's and other operations.

The long-term action plan is aimed to achieve economy through latest energy saving techniques and innovations. The capital investments are required to be studied thoroughly while finalizing the long-term action-plan.

The comprehensive (detailed) energy audit is a thorough and extensive energy audit that analyses and quantifies the amount of energy consumption in each sub system of the plant and compares the same with the target energy consumption. Target per unit energy consumption is the optimum energy consumption per unit product.

The comprehensive audit is quite exhaustive, and it is convenient to split it into following sub parts:

i. Overall system audit:
ii. This accounts for energy leakage/loss through the total system to the atmosphere. The energy conservation measures to eliminate such leakages/loss are recommended.
iii. Functional audit:
iv. It identifies the energy conservation measures in operation and maintenance of each main plant and its subsystems and suggests ECOs is operation and maintenance.
v. Utility Audit:
vi. It identifies yearly/monthly/daily consumption of commercial secondary energy (electricity/petroleum products/fuel etc.) and suggests ECOs.
vii. Modernization audit:
viii. It recommends major changes in the process requiring retrofitting.

Designing an Energy Management Program

Fundamental to the effective implementation of energy efficiency is good management. Like any resource that an organization employs, energy will only be used efficiently if it is managed properly. Good energy management, in itself saves energy**.**

Energy management can be broken down into a number of key areas:

Preparation of Policy Statement

Appointment of Energy Manager

Planning and organizing

Monitoring and control

Conducting an Energy Audit

Motivating People

Reporting and review

Formalized an energy Management Policy Statement.

All these steps are necessary for effective energy management. However, the extent of criticality and type of approach would depend on the nature and size of the organization.

Energy management is a highly cost-effective tool requiring very little capital. None-the less effective application needs total commitment from the top management, allocation of requisite time and patience.

Policy

There should be a formal statement of the organization's objectives, demonstrating senior management commitment to continuous improvement in the efficient use of energy. It should explain the key approaches that the organization will take to achieve these objectives. An effective policy provides the foundation for setting the culture within the organization, and should be clearly communicated throughout the organization.

An effective energy policy should:

- Set out the organization's objectives for energy management. • Demonstrate commitment to managing energy in a way that both supports good business performance and takes due regard for environmental effects.

- Commit the organization, when capital investments are planned, to giving due regard to energy efficiency in the selection and configuration of plant, and adopting the most energy efficient equipment available when the marginal cost is justifiable.
- Recognize the need for adequate resources and reporting through-out the company.
- Identify the Director or Senior Manager with overall responsibility for the energy policy and its implementation;
- Commit the company to a regular review of the policy.

Appoint Energy Manager

The energy manager, who should be a senior staff member, will be responsible for the overall coordination of the program and will report directly to the top management. Energy managers need to have a technical background, must be familiar with organization support from the top management.

Planning and Organizing

To achieve the aims and objectives of the energy policy, there should be clear and formalized responsibilities, plans and procedures in place. These should include:

- Documented roles and responsibilities.
- Plans which set targets for energy savings,and supporting action plans.
- Appropriate methods for communication to ensure that policies and procedures are understood and the management commitment to them is visible.
- Training plans, both for energy managers and the workforce, as appropriate.
- Procedures for planned and emergency maintenance of equipment and the procurement of new plant taking due account of opportunities for energy efficiency.
- Procedures for assessing the cost-effectiveness of energy saving measures.

Monitoring and control

The consumption of energy cannot be effectively controlled without a clear understanding of its use. There are two complementary activities that provide, and help maintain, this understanding:

- The physical energy surveys.
- Ongoing monitoring and analysis of energy consumption information.

Energy survey is an investigation of the control and flow of energy. A survey can range from a simple ‘walk-through’ to a comprehensive and detailed appraisal. In both cases, the aim of the survey is to gain understanding and identify cost-effective energy saving measures. Whatever their level of sophistication, surveys usually include an examination of energy conversion, distribution and end-use, together with management systems. Surveys typically result in recommendations under the categories of no-cost, low cost, medium cost and high cost measures.

At its very basic, the second activity should consist of an examination of energy bills before they are paid and a comparison with expectations, though expectations should not be limited to ‘Is the bill much the same as last month?’

Ideally, the activity often referred to as Monitoring & Targeting (M&T), should be more sophisticated than this, and comprise four main elements:

Data collection from a number of possible sources including energy bills, manual meter readings, automatic meter readings, half –hourly data from utilities; plus, in-house production information and meteorological data as appropriate. Validation of utility bills as part of this activity frequently yields benefits

Analysis and interpretation to turn the data into useful information on which to act.

Reporting of appropriate information, such as unexpected excess consumption, at the right time to the individuals with the ability and responsibility to act.

Action, without which there is little, if any benefit, as well as responding to unexpected excess consumption. This should include the setting and reviewing of standards of performance that managers are charged with achieving.

M&T may seem a little complicated at first, but really is very straightforward and is powerful in identifying waste.

Conduct Energy Audit

An energy audit establishes both – where and how energy is being used and the potential for energy savings. It includes a walk through survey, a review of energy using systems, analysis of energy use and the preparation of an energy budget, and provides a baseline from which energy consumption can be compared overtime. An energy audit can be conducted by a specialist energy auditing firm. An energy audit report also includes recommendations for actions which will result in energy and cost saving.

Motivating People

People are crucial to effective energy management. If the person tasked with energy management is working without the support of others in their organization, their endeavors are likely to be frustrated. Every employee can make a contribution to saving energy, particularly through attention to 'housekeeping' issues, if they have awareness, motivation and empowerment.

Reporting and review

Organizations should provide management reports on energy use and management (progress against plans, conclusions from regular reviews, etc.) in a way appropriate to the size and complexity of the company.

Reporting should include:

- Progress reports as necessary or as required by the appropriate senior management body (e.g. Board) in order to ensure adequate control and review of objectives;
- Frequent reports for operational management control.
- Reviews should include:
- Consideration of the policy (its aims and objectives, scope, adequacy).
- Comparison of quantitative performance against targets.
- Comparison with benchmark data (where available).
- A review of the barriers to the implementation of energy efficiency improvements, and proposals for addressing these as far as possible.

Energy Management Policy Statement

A written energy policy is a commitment to save energy and will guide efforts to improve energy efficiency. It will also help to ensure that the success of the program is not dependent on particular individuals in the organization. An energy management policy statement included a declaration of commitment from senior management as well as general management and aims at specific targets related to:

- Energy consumption reduction
- Energy cost reduction by lowering consumption and negotiating lower unit rates
- Timetables/schedules
- Budgetary limits
- Energy cost centers
- Organization of management resources.

Starting an Energy Management program

Several items contribute to the successful start of an energy management program. They include:

- Visibility of program start-up
- Demonstration of management's commitment to the program
- Making a beginning with simple but effective energy management program.

To be successful, an energy management program must have the backing of the people involved. Obtaining this support is often not an easy task, so careful planning is necessary. The people must:

- Understand why the program exists and what's its goal
- See how the program has full management support; and
- Know what is expected of them.

Communicating this information to the employees is a joint task of management and the energy management coordinator. The company must take the advantage of all existing communication channels.

Negative effect/Impact of energy inefficiencies on businesses

Inefficiency can take many forms, from energy inefficiencies to ineffective workers and poor administration. The results of inefficiency can be as extreme as to cause a business to close its doors.

All of the Power-Star products and services are uniquely equipped to optimize the energy usage at any given site. The online meter allows for seamless transition from recording the electricity usage data to analyzing the information. Monitoring your energy usage and keeping track of it allows you to make decisions with real and independent data. This also saves time for the managers and engineers, problems can be identified as soon as they arise.

What does inefficiency do?

Inefficiency costs money:

Inefficiencies costs many organizations thousands to millions of naira. The loss of capital could have been spent elsewhere. Acquisition of new clients, for research and development and the implementation of new projects would have been a more efficient use of resources.

Inefficiency is when you spend more money than you needed to in order to arrive at the same result.

Power-star can assist in optimizing your energy usage and to cut energy wastage. With the recorded data from our online energy meter we can establish the best possible plan for your site or business. Unhealthy power usage can become a bottomless pit, into which money is thrown. Our Services will allow for efficient energy use that will save money and optimize output.

Energy management services are part of the package, this service consists mainly of changing the behavior of the employers and employees alike. Huge savings can be made by simple adjustments to our behavior for example switching off lights when not needed, etc.

Inefficiency wastes time

We can save a couple of cents here and there, but we cannot squeeze more seconds out of the day. Time is of the utmost importance. Every second lost cannot be regained. When you are waiting for a project to finish or a manager that needs to give you the next set of instructions, these are all forms of wasting time.

Time is not just about time and money, but about potential output as well. An efficient and confident worker will work a lot harder and better than a less confident and underappreciated worker.

We may not be able to help with an underappreciated worker, but we can cut time wastage through the services that we offer. Waiting for reports on finances or your electricity usage reports can waste a lot of time and money.

With our online meter that records data in real time, you will never have to wait ever again. Managers and engineers will benefit greatly by receiving reports in real time and they are able to fix problems as soon as they arise.

Inefficiency reduces quality

Processes improve and methodologies become more succinct, we are often reminded that every defect or missed benchmark is an inefficiency. Correcting energy inefficiencies throughout a process can have a significant influence on the success rates of any business, not only to improve quality but to use the energy effectively.

Power-Star offers a benchmarking service. Each plant manager/engineer will be granted access to the Power-Star software via a secure login. They can remotely monitor the energy consumption as well as set specific benchmarks they wish to monitor that could improve input and output. This may improve overall quality but also improve the cost effectiveness of the products produced. Benchmarks can be used in various business sectors, such as the hospitality or financial sector.

The ISO 50001 Standards: the strategy for loss mitigation across the Electricity Supply Industry (Energy management systems standard)

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ISO 50001: Is a voluntary international standard for energy management systems, was developed by the International Organization for Standardization (ISO). The standard was developed to equip organizations with the requirements of an EnMS or or Energy performance which includes:

- Energy use
- Consumption and
- Efficiency

Purpose of ISO 50001 standard:

The purpose of ISO 50001 standard is to enable organizations to establish systems and processes necessary to improve energy performance. The standard applies to all factors affecting energy use that can be monitored and influenced by an organization. ISO 50001 standard does not specify energy performance criteria. It provides a general-purpose system that allows organizations to choose performance standards that they deem best meet their requirements. Prior to developing the EnMS, the organization should define the scope and boundaries of its management system. The scope refers to the extent of activities, facilities and decisions that the organization addresses through an EnMS, which can include several boundaries. The boundaries are defined as physical or site limits and / or organizational limits as defined by the organization that could be a process, a group of processes, a site, an entire organization and multiple sites under the control of an organization.

The focus of an ISO 50001 EnMS is on improving management processes, practices, and procedures that control an organization's functions and activities with significant energy use. The overarching intent is that by implementing a management process and continually improving this management system, it will eventually lead to an improved energy performance.

The approach of ISO 50001

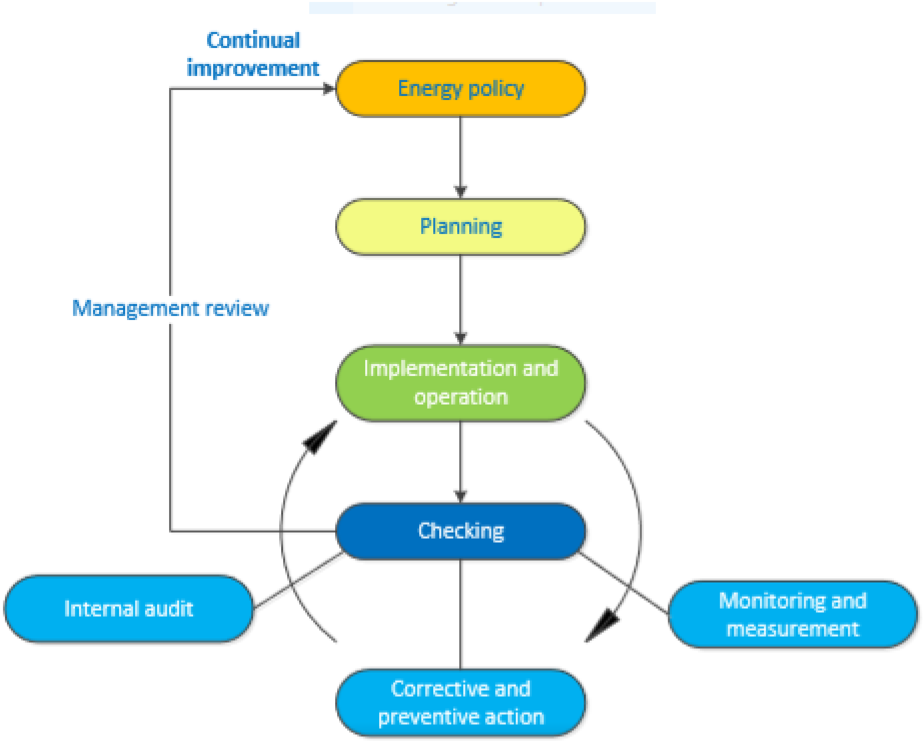
Continual improvement
Energy policy
Planning
Management review
Implementation and operation
Checking
Internal audit
Monitoring and measurement
Corrective and preventive action

Figure 8: The approach of ISO 50001

Understanding the principles of continual improvement

The Plan-Do-Check-Act (PDCA) cycle is the operating principle of all ISO management system standards, including ISO 50001. By following this cycle, you can effectively manage and continually improve your organization’s effectiveness. Whether you are the managing director setting the direction of the business, or an individual focusing on a specific task, the PDCA cycle is very useful in achieving continuous improvement.

Procedure for the implementation of EnMS based on ISO 50001

The standard can be applied in the utility companies through the general principle of: Plan-Do-Check-Act

The four phases in the Plan-Do-Check-Act Cycle involve:

Act: Correct and improve your plans to meet and exceed your planned results

Plan: Establish objectives and draft your plans (analyze your organization’s current systems, establish overall objectives, set interim targets for review and develop plans to achieve them)

Check: Measure and monitor your actual results against your planned objectives

Do: Implement your plans within a structured management framework

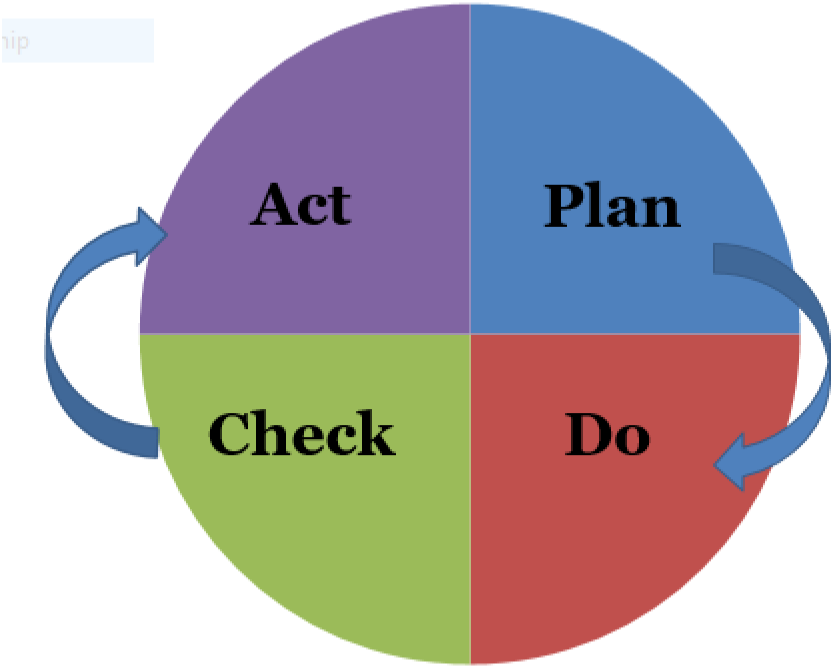

Figure 9: THE PLAN-DO-CHECK-ACT COMPONENTS OF ISO 50001

Plan – Defining your policy, objectives and targets

Management responsibility

Getting commitment from your top level management and communicating this to the wider organization is critical for the success of your organization's energy management system. Ensure a management representative is appointed with the specific responsibility for overseeing the project and ensuring appropriate resources.

Energy policy

Next your business will need to agree an energy policy which states the organization's commitment to achieving energy performance improvement. This should be appropriate to the nature and scale of your energy use and consumption. Remember to include a commitment to continual improvement in energy performance, take into consideration compliance with applicable legal requirements and create a framework for setting and reviewing energy objectives and targets.

Energy planning

ISO 50001 requests that you show evidence that you have conducted and documented an energy planning process which will encourage improvements in energy performance.

Legal and other requirements

There is a requirement at this point for you to prove that your business regularly identifies, accesses and reviews all applicable legislation and external requirements related to energy use, consumption and efficiency.

Energy review

Develop, document and maintain an energy review – for example consider energy sources, consumption, facilities and people that affect energy use. Then identify, prioritize and record how you intend to improve your energy performance based on those factors.

Energy baseline

Make sure you establish an energy baseline using the information from the energy review – this will help you monitor your progress and see improvements over a suitable data period.

Energy performance indicators

These must be identified in order to provide credible performance data which is regularly reviewed and updated as part of your energy management system.

Energy objectives, targets and action plans

Set these for relevant functions, levels, processes or facilities within your organization and make sure that they are consistent with your energy policy. Remember, it's important to review and update these plans at defined intervals.

Do – implementing and living your management system

Competence, training and awareness

Make sure that your employees understand how to meet the requirements of your energy policy and know how they can mitigate impacts on energy use. Training is essential therefore keep records of training in preparation for your review.

Communication

You will need to establish a robust internal communication system and have a defined process for receiving, documenting and responding to external parties. Give the users of the system the ability to suggest amendments or improvements via an agreed internal process.

Documentation and control

Take a look at ISO 50001 which specifies the essential documentation and records which you need to hold, and how these should be controlled and updated.

Operational control

Plan operations and maintenance activities involving significant energy use under specified conditions and communicate these controls to anyone working for or on behalf of the organization.

Design

If you are considering any new facilities, equipment, systems or processes then you must bear in mind how these will impact your energy performance.

Procurement of energy services, products, equipment and energy

When it comes to purchasing, ensure that you define and document energy purchasing specifications and inform your suppliers that procurement is partly evaluated on the basis of energy performance.

Check and Act – measurement review and improvement

Your energy management system is a living framework which needs to be reviewed on a regular basis. Make sure you continue to revisit your energy policy and management objectives to ensure your system remains valuable and relevant to your changing business.

Monitoring and measurement

As part of the certification process you will be assessed to ensure that any operations with a significant effect on energy use are measured, monitored and analyzed at planned intervals so check you have evidence to show that you are doing this!

Evaluation of compliance

Meeting and keeping abreast of legal requirements is an essential requirement of ISO 50001, as is the evaluation and documentation of your organization’s performance against these criteria. Ensure you understand and are up-to-date with any regulation relevant to your business.

Internal audit

You will need to conduct internal audits on a regular basis to ensure the integrity of your management system.

Non-conformities, correction, corrective and preventative action

It will be necessary to show that you have procedures in place to identify, investigate, evaluate, record and review both corrective and preventative actions in line with the severity of the issue, should a nonconformity arise.

Control of records

Take care with your records. Ensure you are able to identify, store, protect, retrieve, retain and dispose of records in accordance with the standard and that they remain legible.

Management review

Management reviews should be scheduled and recorded in order to identify successes, opportunities for improvement and changes that are needed to ensure the system delivers continual improvements to your business.

Conclusion

Energy management is the practice of using energy more efficiently and effectively in an organization’s operations. Energy is a valuable resource and a cost which can be controlled when managed efficiently and effectively. Energy management provides an opportunity to optimize energy costs by understanding energy flow as well as procurement and economics of energy, and reduce its harmful impact on our environment.

Energy audit can help to excavate the maximal energy-saving potential in production and management process, give proposals on energy-saving management and energy-saving technical renovation, promote the progress of management and energy saving technology, and ensure the rapid and healthy development yet developed far enough to be as effective as it needs to be. It will be great once it advances a bit farther, but for the time being, it is not effective enough beyond people who want one in their home to reduce their electricity bills. It is an ongoing process and must be reviewed at regular intervals and fine-tuned as required, from time to time.

Annex

Figure 1: Areas of application of EnMS

Figure 2: System boundary of delivered and exported energy.

Figure 3: power-quality-analyzers

Figure 4: Combustion Analyzer Kit,

Figure 5: Digital Thermometer

Figure 6: Psychrometer (Humidity Measurement)

Figure 7.0: Air Flow Measurement Devices

Figure 8: The approach of ISO 50001

Figure 9: The Plan-Do-Check-Act Components of Iso 50001

Table 1.0: Energy Audit summary for Residential and commercial Buildings

Table 1.1: Energy Audit summary for Industrial facilities